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ABSTRACT

The report describes the development, production and evaluation of an introductory electronics course for the college and university level. Electronics teachers of the four institutions of technology in Sweden developed goals and discussed and revised material. The course that resulted has been widely accepted. (Author/RH)

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Pedagogisk Elektronik

REPORT PE-15

EXPERIENCE FROM DEVELOPMENT OF AN INTRODUCTORY COURSE OF ELECTRONICS

Department of Education, KTH

JUNE 1972

Peter Graham
Gunnar Markesjö

PE-gruppen
KTH

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The Department of Education
Royal Institute of Technology

PE-GROUP

REPORT NR PE-15

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Peter Graham *
Gunnar Markesjö

SUMMERY

The report describes the development, production and evaluation of an introductory electronics course at college and university level. A subject-matter expert group consisting of the electronics teachers of the four institutes of Technology in Sweden developed goals and discussed and revised material from a parallel test and text development. This method has resulted in a concrete and realistic course that has been widely accepted both at university and college level. Structure and teaching strategy have been based on experience from the PE Group´s previous models containing motivation, learning and evaluation. Feedback is a key concept in the model. Feedback in the introductory course is provided through programmed diagnostic tests and a centralised service of final tests and test correction. An evaluation based on test data, results of attitude tests and teacher questionnaires has proved that the course is functioning satisfactorily and is well accepted.

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1. BACKGROUND

Electronics has earlier been regarded as a subject the learning of which must necessarily be based on a thorough knowledge of mathematics and physics. It was, therefore, not earlier taught before years 3 and 4 at the institutes of technology.

The subject-field of electronics has greatly expanded in the last two decades; its practical applications now occur at all levels and within practically all spheres in any way related to technology. A need has thus arisen for elementary electronics teaching based rather on practical applications than on detailed mathematical and physical studies of the underlying phenomena.

As students at institutes of technology spend their first two years chiefly on theoretical studies, the need has also arisen for a combination of this theoretical teaching with one or more applied subjects with a strongly motivating content.

There were accordingly several reasons why a trial with elementary electronics teaching for year 1 was started at the Stockholm Institute of Technology. The first course, "Electronics, Introductory Course", was prepared and run on trial by Ingmar Höglund in the spring of 1968 and the result is presented in Report PE-2.

As a result of the positive experience gained from the introductory electronics teaching at the Stockholm Institute of Technology a corresponding course was included in the curriculum for the Linköping Institute of Technology. It was later decided that electronics should be taught also on other than the electrical engineering line, and as a result the number of students on the course exceeded the critical number 270 for the Linköping Institute (number of seats in the largest lecture-hall). The TRU Committee (Committee for Television and Radio in Education) was then brought in to develop media material, and UKÄ (the Office of the Chancellor of the Universities) formed an expert group to establish the goals for the course (and thus for the development of materials).

As TRU productions are directed to all universities and colleges, representatives from all of them were included in the subject expert group.

2. CHANCELLOR OF THE UNIVERSITIES' SUBJECT EXPERT GROUP FOR APPLIED ELECTRONICS

Experience from the work of earlier expert groups has revealed the difficulty of drawing up specifications of objectives which are directly usable in practice for the production of course material. It is usually easier to include too much in the course objectives than to arrive at a realizable compromise.

2.1 Composition of the group

The expert group formed to draw up the objectives for introductory electronics teaching consisted of the teachers at the various institutes of technology who were directly responsible for the teaching of electronics and of two other members, namely:

Roland Malvén	University Reader	Göteborg
Gunnar Markesjö	University Reader, Chairman	Stockholm
Skotte Mårtensson	University Reader	Lund
Lars O´Nilsson	Student Representative	Lund
Onni Tengner	M.Sc., Secretary	Stockholm
Sven-Erik Wallin	University Reader	Linköping

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Fig. 2
The subject group.

2.2 The work of the group

The work of the group may be divided into three phases:

1) Discussion and establishment of the general goals

2) Discussion of suitable subdivision of the course and formulation of detailed goals

3) Revision of the goals after receipt of comments from organs consulted and after experience of first, provisionally developed course.

The general objective for the course was to give students an introduction to electronic functional units and terminology at an early stage. With this objective in mind, and in view of the short time that could be allotted to the course (35 h), it was assumed that the examination would consist solely of multiple choice questions.

To ensure a concrete and realizable specification of objectives, the diagnostic tests and a preliminary course compendium were developed simultaneously with the specification of objectives.

As regards content, the course was built up around two concrete applications, the oscilloscope and the desk calculator. This approach was chosen in order that the entirety of these two instruments might give students a certain cognitive structure for their studies. A practical application is also usually more motivating for students.

It was decided that the course should start with an analog and continue with a digital section. The relative order between analog and digital sections was determined by the fact that the oscilloscope would have to be used as measuring instrument both in the digital section and in other allied courses. Analog technique normally requires more theory and prior knowledge than digital. In the present course this difference was not so marked owing to the introductory and descriptive character of the course.

The design of the course was drawn up against the background of earlier models of the PE Group (see Reports PE-6 and PE-9). Each section was divided into a number of weekly parts (chapters). Introductory series of tapeslides and follow-up diagnostic tests were also planned.

Thereafter the detailed goals for each section were successively specified. For each section a provisional compendium and a number of multiple choice questions for a diagnostic test were prepared. Feedback was collected both

from reference groups and individuals, who were kept continuously informed about the development material, and from the introductory course of electronics at the Stockholm Institute of Technology, where the provisional compendium was tried out. Goals, text and tests were then successively revised in the group discussions.

The final products of the group´s work were a detailed specification of objectives and proposals for the development of course material, and suitable media (Appendix 1). The media development work, which was to be done by TRU, was, as already mentioned, the chief reason why the expert group was appointed by UKÄ. The proposed media material comprised 13 introductory tape slide presentations (one for each package) and a number of diagnostic tests.

The ad hoc nature of the work of the group gave a static character both to the objectives and to the development of the course. This is especially hazardous in applied technological subjects with a quick rate of change.

The members of the expert group for applied electronics have, however, continued the exchange of experience on their own initiative at regular discussions of objectives, which have now been extended to include the general courses on applied electronics as well.

2.3 Comments on the specification of objectives by the institutions consulted

Some of the comments are presented below in compressed form. The complete comments are available at UKÄ.

K.-O. Orrhagen, Dept. of Systems Engineering, Linköping Institute of Technology, Oct. 8, 1970.

"The Department expresses its great appreciation of the admirable work done by the expert group and of the results achieved. Our experience hitherto of the specification of objectives and of the course literature that has been issued is satisfactory. After an attitude study on Nov. 2, 1970, covering more than 400 students, the results will be passed on to the expert group."

The proposed course requires certain supplementary equipment. 630 students are divided into three groups of 210 students each. Each group takes the course in seven weeks. Parallel laboratory exercises require equipment for 20 laboratory groups and 5 laboratories. AV material and equipment are also required.

Joint Teacher-Student Council, Technological Faculty, Uppsala University, Oct. 18, 1970.
Proposal approved.

Hans Holmqvist, Joint Teacher-Student Council, Electrical Engineering Section, Chalmers Institute of Technology, Oct. 16, 1970.
"The course should meet the following requirements:

a) It should give technology students with varying starting knowledge the same basis for future studies in several applied subjects, such as electrical measurements, circuit electronics, and telecommunications.

b) It should give technology students a knowledge of active and passive components, their structure and characteristics.

c) It should prepare technology students for laboratory exercises in electrical measurements. They should especially learn the oscilloscope, its various elements, and its handling.

The course appears well to fulfil these requirements."

Lennart Stigmark, Joint Teacher-Student Council, Electrical Engineering Section, Lund, Oct. 19, 1970.

"The contents of the course and the specification of objectives give the impression of a reasonable presentation within the analog and digital fields

and should therefore constitute a useful and meaningful introduction to applied electronics as basis for the subsequent subject-fields to be studied."

Sune Berndt, Joint Teacher-Student Council, Aeronautics Section, Stockholm Institute of Technology, Oct. 19, 1970.

"The course is suited for students who will not continue to study electronics. If they are to take electrical engineering courses at higher levels, large parts of the course will have to be recapitulated.

L.E. Nevander, Joint Teacher-Student Council, Civil Engineering Section, Lund, Oct. 19, 1970.

"The Council considers the technique of the detailed specification of goals very interesting but has no means of judging the subject-matter."

Leif-Inge Sandberg, Joint Teacher-Student Council, Technological Faculty, Linköping, Oct. 19, 1970.

"The Joint Teacher-Student Council considers the ideas presented by the expert group to be reasonable and is in agreement with them both as regards the content of the course and the specification of objectives."

Harry Rilbe, Joint Teacher-Student Council, Chemistry Section, Chalmers Institute of Technology, Oct. 20, 1970.

"In its examination of 'Specification of objectives and teaching model for introductory course of applied electronics' the Council has not found it suitable for the Chemistry Section at the Chalmers Institute of Technology. The course is too comprehensive for chemistry students; nor would it appear that it can be adapted to their requirements by simple elimination of superfluous matter."

Rolf Fåk, School of Education, Linköping, Oct. 26, 1970.

Comment by J.-R. Thörnqvist:

Specification of objectives

The objectives are well adapted both for electrical engineering and technical physics students. Students of chemistry, mechanical engineering, aeronautics and shipbuilding have no knowledge of electronic measurements, transducers and converters. Additions should be made in these respects. Builders and architects would hardly have any interest in the course. The rapid developments in electrical engineering require a successive revision both of the specification of objectives and of the design of the course. It is suggested that this should be done at 2-year intervals.

Usability of the course

"Without doubt the course, in the form in which it is presented, is suited for university level, especially for institutes of technology. The university lines within other branches of natural science - physics, chemistry, medicine, biology etc. - should also derive value from the course.

The course material should be well suited also within the subject of electronics, year 3 of Technical College, Electrical Engineering. The course well covers the main objectives set up for it."

Other comments

"In view of the fairly extensive arsenal of teaching aids planned for the course, and the rapid development of electronics, the expert group for applied electronics should be made permanent and commissioned to continuously revise the course."

3. DETERMINATION OF GOALS - DESIGN OF TESTS

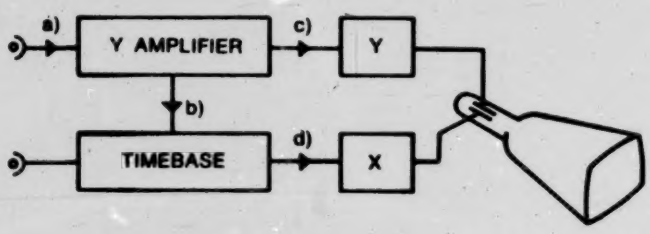
As electronics is an extensive subject, it is impossible even superficially to cover it with an introductory course. At an early stage, therefore, two important applications - the oscilloscope and the desk calculator - were chosen as basis for the course.

The most important aspects were considered to be function, structure, building blocks, components, and terminology. With these premises concrete goals could then be discussed, e.g. what components should be described, how detailed the description should be, and how the students should present the results of their work. The goals were then formulated in fairly specified form in behavioural terms for each section. On the basis of these preliminary goals and of provisional sections of the course, diagnostic tests of multiple choice question type were then developed. Goals, text and tests were discussed and continuously revised by the expert group.

There was also the question of the final test for the course. To simplify this work, a common test items bank was set up in order to permit an exchange of tests between the various institutes of technology. For each test question in the bank the results from the item analyses have been compiled so as to be able to check the quality, difficulty and discriminating capacity of the questions. Work is at present being done on giving the bank an easily reproducible and practical form. Fig. 2 shows an example of a question from the bank and the associated statistics.

Fig. 2
An example of a question from the item bank and the associated statistics.

One can get the beginning of a wave form before the trigger point by introducing a delay line in the oscilloscope. Where should it be placed?



STATISTICS:

ITEM 9 1022-080-103 23 MAY 1970
INTRODUCTORY COURSE

ALTERNATIVE	A	B	C	D	E	X
CORRECT ANSWER			*			
RESPONSE FREQ	1	4	45	1	0	0
" PROP	0.020	0.078	0.882	0.020	0.000	0.000
MEAN SCORE	32.000	27.250	33.711	28.000	0.000	0.000

R(POINT BISERIAL) = 0.356 R(BISERIAL) = 0.58

ITEM 6 1022-151-106 23 JANUARY 1971
INTRODUCTORY COURSE

ALTERNATIVE	A	B	C	D	E	X
CORRECT ANSWER			*			
RESPONSE FREQ	4	23	91	19	0	0
" PROP	0.029	0.168	0.664	0.139	0.000	0.000
MEAN SCORE	30.750	28.609	33.176	26.947	0.000	0.000

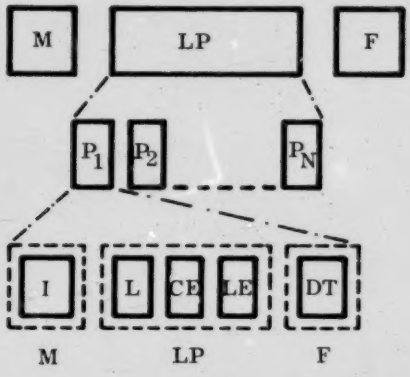
R(POINT BISERIAL) = 0.472 R(BISERIAL) = 0.61

4. DIFFERENT TYPES OF COURSE MATERIAL

The choice of course material depends on a number of factors - objectives, students' learning habits, time allotted for the subject, resources and available laboratory equipment, etc. An important factor is the model which the teaching is intended to follow. The course material is therefore described below with reference to the teaching model used, the principle of which is presented in fig. 3 (see also Report PE-14).

Both for the course as a whole and for each package a division can be made into the three basic components - motivation (and introduction), learning activities and follow-up.

As the main goals for the course well meet the requirements both of university and college and of upper secondary school level (see Comments under 2.3), the material for electronic circuit calculation and laboratory exercises was also constructed to adapt the course to the essentially more extensive time allotted for class 3 of upper secondary school (90 h compared with 35 h at universities and colleges).



Notations

M = motivation
LP = learning process
F = follow-up
P = package
I = illustrative material
L = lecture
LE = laboratory exercise
DT = diagnostic test
CE = calculation exercise

Fig. 3
Teaching model

4.1 Introduction and motivation

A good introduction of the course material is essential. For this purpose two tape slides were chosen, one for each part of the course. The first deals with material, methods, the application to be studied (the oscilloscope), and the subject-field (analog circuits). In the latter the main emphasis has been placed on the application (the desk calculator) and the subject-field (digital circuits).

From the start the intention was that each package should be introduced by a TV program (of the type earlier used in the TV project of the PE Group, Report PE-8). After the text material had been put through a satisfactory trial run, however, UKÄ changed its mind and economized on the media costs. In order not to miss the introductory and motivational elements in the packages, each package was introduced by lexivisual picture summaries in the textbooks.

4.2 Material for learning activities

The original layout comprised 12 packages. The textbooks for the two parts of the course were therefore composed of 6 chapters each (about 20 pages per chapter). It was found that the degree of difficulty and coverage could not be made to coincide with a division of the contents into 12 chapters demanding equal amounts of work. To obtain a more uniform division of labour, therefore, a breakdown was made into set tasks as shown in fig. 4.

In conjunction with each set task there is an illustrative laboratory experiment. Meaningful laboratory experiments cannot be subsequently introduced in a course divided into set tasks. The laboratory experiments, therefore, played

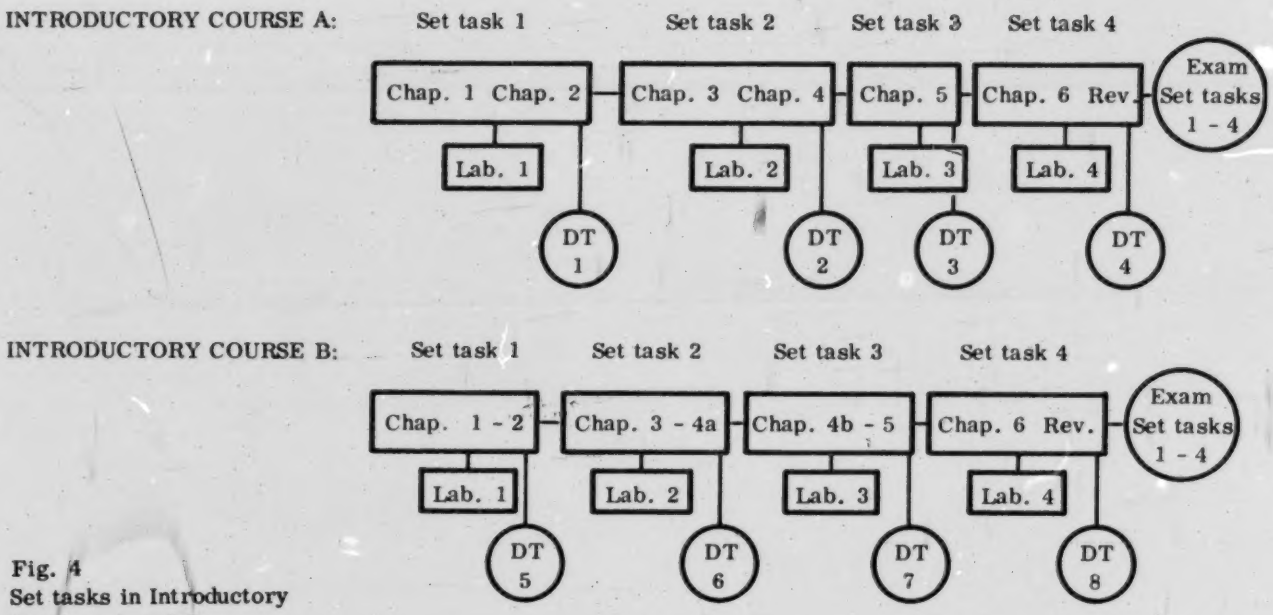


Fig. 4
Set tasks in Introductory Courses A and B

a decisive role in the division of the course material into set tasks. The final arrangement of the eight set tasks was based on the experience gained from the trial run.

Instructions, containing also preparatory tasks, were developed for the laboratory exercises.

4.3 Follow-up

Diagnostic tests, one for each set task, are used to provide feedback information to students, teachers and course developers, Results of examinations and attitude tests are used for follow-up of the course as a whole. The diagnostic tests were given the form of multiple choice questions on overhead projector transparencies with the question recorded on tape (which thus also determines the time for answering).

The examination is in the form of stencilled multiple choice questions and problems, with a central marking service.

5. PRODUCTION OF COURSE MATERIAL

The course material hitherto produced for "Electronics, Introductory Course" consists of

2 textbooks
2 laboratory exercise books
2 calculation exercise books
2 tape slide series
7 experimental kits
8 diagnostic tests
Teachers guide
Central examination service etc.

The teaching aid package was produced by Läromedelsförlagen in cooperation with Terco AB, who also produced the experimental kits.

The course material will be seen from figs. 5 - 8.

Some of the problems connected with the production of the textbooks, diagnostic tests, experimental kits, electronic circuit calculation exercise books and teacher´s guide are discussed below.

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Fig. 5
Textbooks, workbooks and introductory tape-slide series

Fig. 6
Programmed diagnostic tests. Each test has a set of overhead transparencies and a tape.

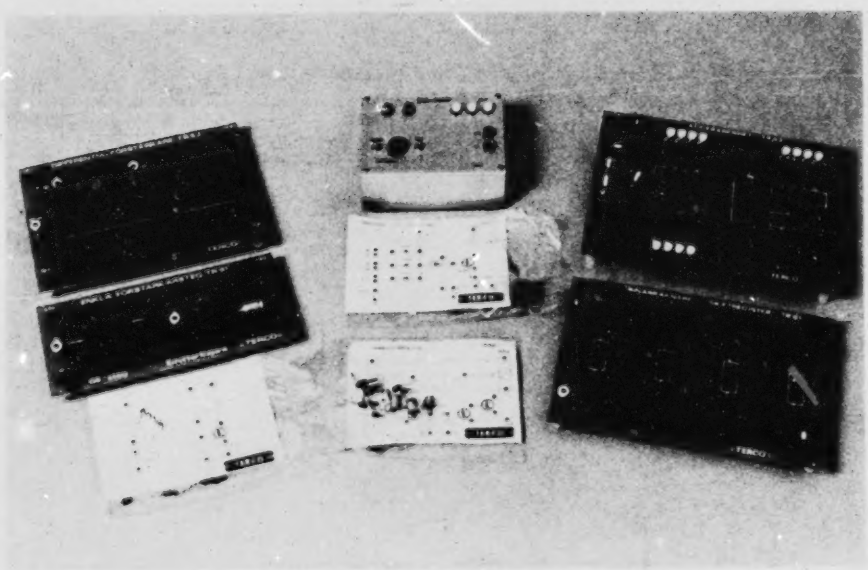

Fig. 7
Laboratory experiments in kits.

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Fig. 8
Teacher's guide and central test correction service.

5.1 The textbooks

Preliminary stencilled copies were circulated to the expert group and to other parties (including Karolinska Institutet and certain upper secondary schools) and the course was given a trial run at the Stockholm Institute of Technology. After corrections and redrafting of certain sections the revised manuscript was taken over by Roswitha von der Schulenburg, who acted as project leader for the work at Läromedelsförlagen, including the responsibility for editing layout, photographs, reproduction of diagrams, and the lexivisual summeries. The time margins for the production (from handover of the manuscript to final production of the book) were very small. The project was started in January 1970. The corrected manuscript for Course A was handed over in May and the textbook (Course A) was delivered from the press in August 1970.

This rapid pace of work was conditional on acceptance by the publishing company of the responsibility for coordination of layout and production to a very much greater extent than normally.

5.2 Diagnostic tests

The diagnostic tests (8 tests with 12 questions each) were produced as overhead transparencies and sound tapes. Earlier enquiries have shown that electronics teacher rather prefer to have questions presented on overhead than

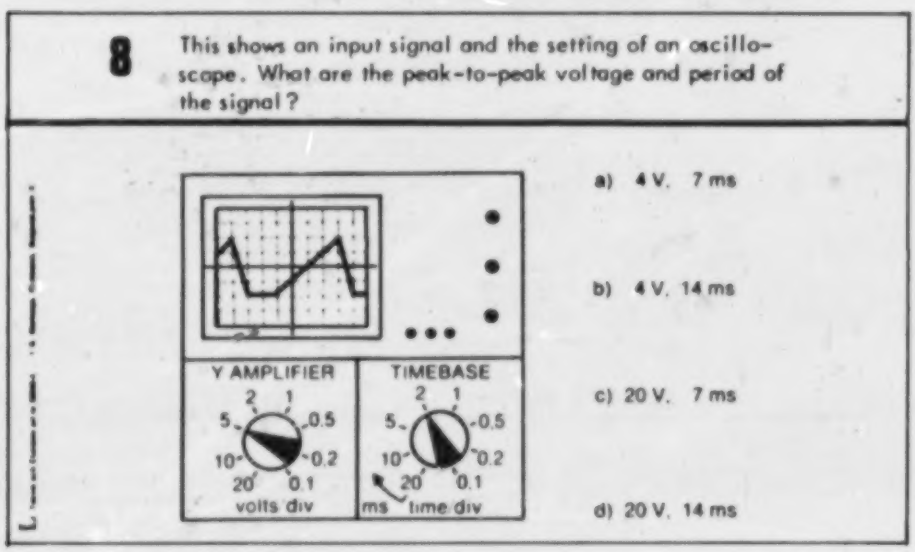

8
This shows an input signal and the setting of an oscilloscope. What are the peak-to-peak voltage and period of the signal?
Y AMPLIFIER
TIMEBASE
2 1 5 0.5 10 0.2 20 0.1
volts div
ms time div
a) 4 V. 7 ms
b) 4 V. 14 ms
c) 20 V. 7 ms
d) 20 V. 14 ms

Fig. 9
Question from a diagnostic test. The question is presented via overhead transparency and tape.

on slides. Perusal and discussion of the correct answers is simplified when the teacher can use a transparency for drawing and commenting. An example of a question is shown in fig. 9.

5.3 Experimental kits and instructions for laboratory exercises

Prototypes for the eight laboratory experiments were developed on the basis of the ideas earlier discussed by the expert group. The experiments were selected so as to keep the costs of fixed equipment and expendable materials at a low level. Responsible for the prototype development was Christer Eriksson of the Department of Applied Electronics. On the basis of these prototypes (including measurement data) J.-R. Thörnqvist, Lecturer at the Linköping Institute of Technology, drew up directions for the experiments adapted to upper secondary school level. For each experiment the compendia include goals, supplementary theory, preparatory tasks, instructions for carrying out the experiment and for recording the results. By drawing on the services of two specialists in this way, one for circuit development and construction and one for adaptation of the experiments to the school environment, some of the common mistakes which so often limit the use of experimental kits in practice were avoided.

The final design of the experimental kits (with regard, for instance, to price and availability on the components market, design of printed circuit boards, etc.) was done by AB Terco. Terco have earlier marketed a large range of laboratory equipment in the schools sector and therefore have close contact with school requirements.

5.4 Electronic circuit calculation exercise books

"Electronics, Introductory Course" was originally intended as a purely introductory course at college level (with the emphasis on terminology and functional units and with examination of multiple choice question type). The use of the course material in class 3 of upper secondary school, therefore, required that it should be expanded and supplemented by a set of examples. This was produced and used on trial at Åsö Gymnasium by three of its masters - Messrs Arve, Jonsson and Lindström.

5.5 Teacher´s guide

The teacher´s guide was produced after the textbook had been used during a trial year at upper secondary school. It was thus based both on experience from the first year of its use and from a schools conference on electronics teaching at upper secondary level (see 7 below). It was put into its final form by J.-R. Thörnqvist.

6. EXPERIENCE FROM TRIAL RUN AT INSTITUTE OF TECHNOLOGY LEVEL

"Electronics, Introductory Course" has now been run for two years for more than 1000 students (all institutes of technology in the country). The experience of the course at these institutes now exists in the form of examination results, attitude tests, and from subject-teacher conferences.

In the first year the course was run on a voluntary basis for class E1 at the Stockholm Institute of Technology; the result of the compulsory evaluation is shown in fig. 10. As appears from the questionnaire, the object of the evaluation is "to serve as an alarm" if "the adaptation of the course to the students is not what it should be".

Even taking into account that the attendance was voluntary and that the Hawthorne effect may have had an effect on the distribution of answers, it is striking how positive a reception the course met with on the part of students. The information on the goals (question 1) was considered satisfactory and the students manifestly felt that the examination provided a satisfactory test in

ROYAL INSTITUTE OF TECHNOLOGY
STOCKHOLM
Faculty Teacher-Student Council
Working Group for Evaluation of Teaching

APPLIED ELECTRONICS
INTRODUCTORY COURSE
MAY 23, 1970

GENERAL EVALUATION OF COURSES AT THE INSTITUTE

Course No. **E 7.011**

The evaluation is intended to serve as an "alarm", i.e. give the teachers a signal that the adaptation of the course to the students is not what it should be.

The form should be completed by all who take the end-of-course examination. The principle of optical reading is used and the completed answer form should be handed in separately at the same time as the examination paper. The answer forms will be sent direct to the Service Group for Optical Reading. The results will be communicated by the Group to the teacher, the Section Teacher-Student Council, the Section Students Council, and will also be shown on notice boards.

INSTRUCTION

- Answer questions 1 - 6 from your experience of the course.
- Enter the serial no. and course no. on the answer form.
- Transfer your answers A - E to questions 1 - 6 to the answer form.
- Hand in the answer form with your examination paper.

PERCENTAGE DISTRIBUTION

QUESTIONS	A	B	C	D	E
1. What is your opinion of the information concerning the objectives and aim for the subject?	Bad	Un-satisfactory	Acceptable	Good	Very good
	0	0	12	65	23
2. To what extent are you satisfied with your influence on the teaching and examination?	Dissatisfied	Not satisfied	Partially satisfied	Satisfied	Very satisfied
	0	2	27	68	4
3. What proportion of the teaching needs to be essentially improved from a pedagogic aspect?	0 - 20 %	20 % - 40 %	40 % - 60 %	60 % - 80 %	80 % - 100 %
	65	29	4	2	0
4. To what extent do you consider that the examination tests your knowledge of the subject-matter?	Not at all	Un-satisfactorily	Acceptably	Well	Very well
	0	2	2	54	42
5. What do you think about the burden of work involved in the course?	None	Slight	Normal	Severe	Very severe
	10	65	25	0	0
6. What is the value of the course for you with a thought for your probable future work?	Valueless	Little value	Some value	Valuable	Great value
	0	4	29	56	10

48 students present

Fig. 10
Result of evaluation of course at Stockholm Institute of Technology

accordance with the goals (question 5). The course was considered of value (question 6) but despite its length has not imposed an undue burden on students (question 4).

In the first year - when the course was voluntary at the Stockholm Institute of Technology - we noticed a marked difference in starting knowledge in the pretest for continued teaching of electronics, in year 2 (General Course, Part 2, Digital circuits). Fig. 11 shows the results of the pretest for students who in the preceding year had taken the introductory course in year 1 and for students who did not feel that they had time or energy to take the voluntary course.

A goal for the introductory course of electronics has been to give students not earlier familiar with electronics a basis for further studies. The result of the voluntary course, however, shows that one does not reach the proper target group on a voluntary basis. The course is now compulsory - but an exemption is allowed for pupils who have taken a similar course at upper secondary school. The latter group constituted more than 25 % of the E1 students at the Stockholm Institute of Technology in the academic year 1971/72.

a) Results Introductory course students alone				b) Results excluding Introductory course students	
Grade	Points	Freq.	Histogram	Freq.	Histogram
	30	0		1	x
9	29	0		0	
	28	2	x x	0	
	27	4	x x x x	2	x x
8	26	8	x x x x x x x x	2	x x
	25	1	x	8	x x x x x x x x
	24	7	x x x x x x x	5	x x x x x
7	23	1	x	7	x x x x x x x
	22	3	x x x	7	x x x x x x x
6	21	2	x x	3	x x x
	20	6	x x x x x x	6	x x x x x x
	19	1	x	7	x x x x x x x
5	18	3	x x x	9	x x x x x x x x x
	17	1	x	9	x x x x x x x x x
4	16	0		3	x x x
	15	0		9	x x x x x x x x x
	14	0		4	x x x x
3	13	0		5	x x x x x
	12	0		4	x x x x
2	11	0		4	x x x x
	10	1	x	0	
	9	0		3	x x x
	8	0		1	x
1	7	0		1	x

Fig. 11
Result of pretest (Jan. 19, 1971) for Digital Circuits Course for E2.

a) Students who took introductory course (voluntarily).

b) Students who did not take introductory course.

In the academic year 1971/72 the Electronics Course was given to 556 students at Linköping Institute of Technology. The experience from Linköping is presented in "Report on trial with pedagogic working group within course 21.120 Applied Electronics I" dated Feb. 29.

During the course regular meetings were held with the teachers concerned, and Leif Bengtsson reports the following experience.

Leif Bengtsson: "Summary of the points of view put forward at the teachers´ discussion at the end of the course.

Duration of course

To reduce the intensity of the course it was suggested that next year the teaching should be spread over the whole term with examination in the January period.

Prior knowledge

In the laboratory exercises it was noticed that the handiness with voltmeters and ammeters was exceptionally poor. In general the students seemed to be unused to work in the laboratory.

To improve this situation it was suggested that an extra laboratory exercise should be arranged (possibly voluntary) in period 0, covering measurements with voltmeter and ammeter.

Course literature

The course literature was judged to be satisfactory in content and scope, but criticism was directed against the arrangement of the subject-matter. First to outline the structure of the object to be analysed and introduce new concepts, then coming in due course to the details and only thereafter explaining the new concepts, was considered an unsuitable arrangement.

As regards the instructions for the laboratory exercises it was considered that, as solutions and answers to the preparatory tasks are given at the end of the book, the student is not stimulated to attempt to solve the problems on his own.

Planning

It is presumably inadvisable to place the calculation exercises directly after the lectures, as the students do not then have time to digest the matter from the lectures.

Too little time was allowed for the properties of the transistor.

To give more time for the more difficult sections it was proposed that the section on passive components should be left for independent study.

Laboratory exercises

An unnecessarily large part of the laboratory time was spent on nailing and soldering and it was suggested that this work should be done during the soldering course in period 0.

An offprint of the laboratory exercise instructions, dealing solely with the exercises in the course, should be issued.

Examination

All questions should have the same number of alternative answers.

In the next examination, questions relating to the same section of the course should be kept together. Previously the questions have been mixed entirely at random.

Through this change the examination results may be improved.

General points of view

According to the evaluation of the course the students´ attitude to the course literature was markedly positive, and one therefore wonders whether the teachers´ criticism is justified.

The evaluation also reveals that the value of the calculation exercises was considered greater than that of the lectures. It might therefore be better to increase the number of periods on calculation exercises at the expense of the lecture periods despite the greater cost.

It is interesting to compare the examination results for the extra intake with those for the regular intake. Although the extra intake had six hours less teaching, their examination results were markedly better. One may wonder about the reason.

On the basis of the results of the examination and of the evaluation of the course there does not appear to be reason to make any major change in its arrangement. Certain of the suggested changes should be made and the examination results may then be improved."

The students' attitudes appear clearly from the evaluation of the course. A 5-degree scale was used, of the following type

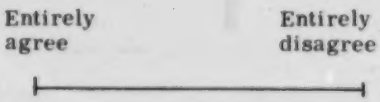
Entirely agree — Entirely disagree

0	1	2	3	4	5

The median value for uniform distribution of answers is 2.5. On the following page the median values are given for answers from 333 students (on Nov. 29, 1971) to questions under the headings:

General questions (11 - 16)
Questions on course literature (17 - 19)
Questions on examination tasks (38 - 40)

Extract from
"Report on Course 20.120 Applied Electronics, Academic Year 71/72"



General questions

11. The course as a whole was very satisfactory.
12. The subject-matter in relation to my starting knowledge was very easy.
13. I think that the knowledge I have acquired on the course will be of very great use to me in my future career or subsequent studies.
14. I needed to do very little home-work to keep abreast of the teaching.
15. My possibility of influencing the form of the teaching was, I felt, very great.
16. Having regard to the scope of the subject, the degree of difficulty, and the possibility of assimilating the subject-matter, the time allotted to the course was unnecessarily long.

Questions concerning the course literature

17. The course literature was as a whole very satisfactory.

18. The theory sections in the literature have been well concretized through examples of applications.

19. Very little supplementary literature was needed for this course.

Questions concerning examination tasks

38. The examination tasks well cover the subject-matter.

39. The examination tasks very closely followed the earlier calculation exercises.

40. The course literature very well covers the examination tasks.

From the answers to the questions concerning the course literature it appears that as a whole it has been greatly appreciated (question 17). Examples of applications are clearly felt to be lacking (question 18), despite which it is not considered that the literature needs to be supplemented. (A set of examples has been published, but in this case was not used.)

Under the heading "Questions concerning examination tasks" the students give very strong expression to their opinion that the examination tasks cover the subject-matter of the course, and vice versa (questions 38 and 40). The goal of the course is manifestly well understood by the students and the course literature well adapted to the goal.

7. EXPERIENCE OF RUNNING OF THE COURSE AT UPPER SECONDARY SCHOOL LEVEL

During 70/71 and 71/72 the course was given to some fifty electronics classes in year 3 at upper secondary schools (of altogether 100 in the country). Some 25 of these classes made use of the central examination service which was supplied at the request of teachers. This service has been specially appreciated by the smaller rural schools. Owing to the wide spread in the timetables the central follow-up of the diagnostic tests could not be done until the end of the course. There have been certain problems also in co-ordinating the dates for the examinations, but it should be possible to overcome these problems by earlier planning.

Questionnaires have been addressed both to students and teachers in conjunction with the examinations. The results of these opinion polls are presented in appendices 2 and 3.

7.1 Comments on the opinion polls

7.1.1 Students´ opinion polls

The students´ opinion polls in appendix 2 show that the students are highly motivated for electronics (question 1 Spring term -71/question 41 Spring term -72 A) and that they considered they possessed an adequate starting knowledge for the course (5, 29/-). The introductory tape slide presentations are appreciated (34/47). The introductory picture summaries for each chapter are considered interesting, easy to understand, and have been used

to a great extent (2, 3, 33/51, 57). The objectives set out at the beginning of each chapter provide good guidances for the studies and are reasonably detailed (14, 15, 32/52). The course as a whole is considered as neither too difficult nor too easy, whereas the section on the conduction mechanisms of semiconductors is rather too difficult (7, 10, 17, 28/42, 54, 56, 58). The diagnostic tests are of reasonable difficulty, but the time for answering should possibly be longer. The students are concerned about the results of their tests and feel that they learn a considerable amount from the tests (11, 12, 13, 17, 18, 19, 20, 22, 23/45, 46, 50, 55). The laboratory exercises are reasonably hard and one learns from them. The nail labs, which are not felt to take an unnecessarily long time, are popular (7, 8, 9/58).

The students´ opinion poll after introductory course B, Spring term -72, is commented separately below.

The textbook is not considered too difficult (41) and the chapter on the function of an electronic calculator is of essential importance (42). The students are highly motivated for digital technique (43) and do not want the digital course reduced in favour of the analog course (44). Scheduled time for the analog course is considered too short though (58). The calculation exercises are of reasonable difficulty (45, 46). The laboratory exercises are interesting (48) and the circuit boards are easy to work with (49). The diagnostic tests are both activating (56) and give direct feedback in class (54, 55).

7.1.2 Teachers´ opinion poll 70/71

The results of the teachers opinion polls are presented in appendix 3. The specifications of objectives are well and sufficiently defined to indicate the framework for the week´s work (2, 7). Most teachers have allowed pupils to spend up to 25 % of the lesson-period on independent study (3). Most classes have carried out all laboratory exercises in the analog section but only exercises 1 and 2 in the digital section. Nearly all teachers have used the ready-made experimental kits (10, 11). All students have had access to the laboratory exercise books; the books have been considered to be reasonably comprehensive and to provide sufficient information (4, 5, 8, 15). The students have spent on an average between three and four hours on every laboratory exercise in the analog section and slightly less in the digital (13).

The diagnostic tests for the analog section have been used by all teachers. The difficulty of the tests has been considered to increase, from rather too easy for test 1 to rather too difficult for test 4. In the digital section only a few classes had time for the last two tests. The difficulty of the digital tests was considered reasonable (17, 18). The diagnostic tests have had an activating effect on the students and have often led to discussions of the problems involved. Most teachers have quickly gone through and corrected the results of the tests but have seldom let them have an influence on their teaching (19 - 23).

On the basis of the experience of the electronics course we have asked the teachers to evaluate the various components in an imaginary teaching aid system, using a scale of 5 (absolutely necessary) to 1 (irrelevant). The resulting ranking was as follows (25):

1. textbook
2. work-book
3. diagnostic tests
4. specification of objectives
5. central examinations and marking service
6. teacher´s guide
7. ready-made experimental kits

8. motivational tape slide series or TV programs
9. information meetings for teachers on pedagogic planning and contents of the course
10. extra exercising and working materials for backward students
11. bibliographical references for bright students
12. marking service for the diagnostic tests

7.1.3 Teachers´ opinion poll for Introductory Course A, March 72

The teacher´s guide was published so late that most teachers could not make use of the detailed plan. The rough plan, however, suits most teachers well. Seventy-five per cent are satisfied with the time allotment between analog and digital. All have used the course material; some have used, in addition, stencilled notes of their own on electron tubes, and two have used Siemens´ film strips. The calculation exercises are generally considered to be of reasonable difficulty, but a desire has been expressed for more simple tasks for independent study.

Some teachers consider the course too comprehensive, others would like the section on amplifiers to be extended at the expense of other sections, and others would like the discussion of conductive mechanisms of semiconductors to be based more on physics.

7.2 Conference on Electronics, June 8, 1971, at Åsö Gymnasium

Some forty electronics teachers from the entire country were invited by the Stockholm Local Education Authority to discuss various proposals for an electronics curriculum for year 3 of upper secondary school. Five discussion groups were formed, all with the task of proposing a curriculum for electronics in year 3 under the following main headings:

1. Specification of content
2. What are the requirements in respect of different goals such as:
   a) survey of subject-field
   b) terminology
   c) ability to use data sheets
   d) solution of problems
   e) proficiency in laboratory work
3. Choice of method

The five groups arrived at similar results.

They considered that in year 3 a concentrated study of electronics should be made during the Spring term. It should to a greater extent constitute a direct preparation for year 4 (70 - 80 % of pupils go on to year 4). Both analog and digital technique should be included, even if less time is allotted to digital (max. 40 %).

The most important goals were considered to be

a knowledge of passive and active components,

the ability to interpret their data sheets,

proficiency in solution of problems,

ability to use the oscilloscope as measuring instrument.

It was suggested that semiconductor physics should be dealt with in a concentrated half-day within the subject of physics.

The conference´s suggestions were used as basis for the preparation of the teacher´s guide referred to under 5.5.

8. SUMMARY AND CONCLUSIONS

This project, comprising the development, adaptation and evaluation of an introductory course on electronics at college level, has now been run on trial for two years and has provided much valuable experience.

In this project we have tried out a working method for the development of a practically functioning objectives/tests system. This was made possible through the creation by the Chancellor of the Universities of a subject expert group for applied electronics. It was of great significance that the membership of the group was well chosen. Work on the project was very intense in its first phase, which meant that the group's work was both inspiring and effective. The integrated method of working, under which objectives, tests and materials were elaborated and discussed almost in parallel, gave the course a concrete and realistic form at an early stage. The course has been run at the four institutes of technology during two years with satisfactory results.

As the main goals of the course coincide to a large extent with the need for electronics teaching at upper secondary school level, the course has found a wide use at these schools as well after certain additions in respect of the activity elements.

An essential contributory reason for the use of the material in different spheres is presumably that the teacher is given service in the most laborious sections of the teaching (see ranking list on page 16).

The combination of specific goals and a course material which is complete and can later be used without placing too heavy a load on the teacher has led to its use by several firms for their internal training (e.g. the L M Ericsson Telephone Company and SWEDA).

Methods as well as material have attracted an international interest (translations are being made into German, English, Spanish, Portugese and Finnish).

The models and feedback mechanisms tried out in the project have proved to meet a great need and have functioned satisfactorily.

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UNIVERSITETSKANSLERSÄMBETET
Ämnesexpertgruppen för tillämpad elektronik
Fbs C Tengner, IP

18.8.1970

BEST COPY AVAILABLE

Målbeskrivning samt undervisningsmodell för inledande kurs i tillämpad elektronik, utarbetad av UKÄ:s ämnesexpertgrupp för tillämpad elektronik

INNEHÅLL

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2.2 Kursinnehåll

2.3 Kursmål

3 Undervisningsmodell

1 Introduktion

1.1 Uppdraget

Enligt beslut av statsmakterna skall utbildningen vid Linköpings högskola till viss del ske med hjälp av förproducerade TV-kurser.

För att utreda hur man lämpligast använder radio och television i utbildningen tillsattes i februari 1967 kommittén för television och radio i utbildningen (TRU-kommittén). Denna fick i uppdrag att inkomma med förslag till lösning av de olika principiella organisatoriska problem som är förknippade med ökad användning av radio och television på utbildnings- och bildningsområdet. I samband härmed skulle kommittén leda och planera en försöksverksamhet. Genom denna verksamhet skulle behovet av bandade program för Linköpings högskola tillgodoses.

I prop 1968:83 påpekar föredragande statsrådet att de televisionsprogram som framställes för Linköpings högskola skall kunna användas även vid övriga tekniska högskoleenheter.

För att utarbeta underlag i de läroämnen där undervisningen avses ske med hjälp av förproducerat material har UKÄ tillkallat ämnesexperter som uppdelats på ett antal ämnesexpertgrupper.

I ämnesexpertgruppen för tillämpad elektronik ingår:

G Markesjö	universitetslektor ordf	KTH
R Malvén	"	CTH
S Mårtensson	"	LTH
L O Nilsson	teknolog	SFS
S-E Wallin	universitetslektor	Li

Gruppens sekreterare är civilingenjör O Tengner, UKÄ.

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De universitetslektorer som ingår i gruppen är ansvariga för det praktiska genomförandet av bl a den inledande undervisningen i tillämpad elektronik på högskolenivå. En studentrepresentant har ingått i gruppen. Till gruppens sammanträden har adjungerats en testspecialist samt vid vissa tillfällen en pedagogisk konsult.

Direktiven anger att gruppen skall utarbeta en målbeskrivning för den inledande undervisningen i tillämpad elektronik.

Enligt lärc- och timplanen för Linköpings högskola omfattar den inledande kursen i tillämpad elektronik, benämnd Tillämpad elektronik I, 35 timmar schemalagd tid. Den ges för samtliga utbildningslinjer under första årskursen.

1.2 Beskrivning av expertgruppens arbete

För att nå en konkret och realiserbar målbeskrivning har såväl diagnostiska prov som ett preliminärt kurskompendium utarbetats parallellt med målbeskrivningen.

Kursen har en inledande och översiktlig karaktär samt ett stort elevunderlag. Redan i initialskedet beslöts därför att tentamen enbart skulle bestå av flervalsprov.

I början av gruppens arbete togs kontakt med ämnesexpertgruppen i elektroteknik, vilken planerat kursen Elektroteknik I som läses i andra och tredje årskurserna av utbildningslinjerna för maskinteknik och ekonomingenjörsutbildning vid Linköpings högskola. Härvid innämtades synpunkter från ämnesexpertgruppen i elektroteknik på innehållet i och uppläggningen av kursen Tillämpad elektroteknik I och en samordning av de båda kurserna skedde.

Arbetet har genomförts enligt följande:

1

För att eleverna hela tiden skall ha en realistisk tillämpning som grund för sina studier av komponenter, funktionsenheter och byggblock beslöts att bygga upp kursen kring ett oscilloskop (som analog tillämpning) och en elektronisk bordsräknemaskin (som digital tillämpning).

2

Den sammanfattande målbeskrivningen (punkterna 1-5 sid 23) uppställdes.

3

En preliminär sekvensering av stoffet i en analog och en digital kursdel utfördes.

4

En preliminär målbeskrivning gjordes med utgångspunkt från stoffets sekvensering och denna målbeskrivning fick ligga till grund för en försöksutskrift av ett kompendium (som stencilerades och cirkulerades även till ett antal referenter utanför expertgruppen).

5

Med kompendiet som utgångspunkt vidtog detaljerade diskussioner om innehåll och utformning som ledde fram till de mera detaljerat specificerade kursmålen för de olika kapitlen.

6

En prototyptest för motsvarande kurs vid KTH utarbetades samtidigt som kompendiet reviderades. Testen diskuterades i expertgruppen.

7

Kompendiet och testen provades på första årskursen, E-sektionen, KTH och reviderades.

2 Kursinnehåll och målbeskrivning

2.1 Kursens målsättning

Kursen syftar till att skapa medvetenhet om den tillämpade elektroniken och dess betydelse för andra tekniska områden. I kursen ges en allmän kännedom om de elektroniska byggblocken, dess komponenter, uppbyggnad och funktion. Därvid introduceras på ett tidigt stadium den terminologi som används inom elektroniken.

Som ett led i målsättningen sker inlärningen i anslutning till elektroniska tillämpningar. Sålunda skall ett oscilloskop och en elektronisk räknemaskin analyseras med avseende på funktion, uppbyggnad, byggblock och komponenter. Oscillogskopet innehåller huvudsakligen analoga kretsar och den elektroniska räknemaskinen digitala kretsar.

2.2 Kursinnehåll

Analoga delen

1 Byggblock och funktionsenheter

Analog och digital teknik, analoga och digitala tidmätare, analog/digital-omvandlare.

2 Oscilloskopet

Oscilloskopets funktion; bildröret, Y-basförstärkaren och tidbasgeneratorn, tidbasgeneratorns triggning. Typoscilloskopet; uppbyggnad, grundinställning, blockschema. Exempel på allmänbruksoscilloskop, tvåkanalinsatsen, proben och kalibratorn.

3 Passiva komponenter

Komponenter, symboler och färgkoder. Resistorer; (kolskiktsmotstånd, metallfilmsmotstånd, trådlindade motstånd, variabla motstånd, termistorer och varistorer). Kondensatorer; (plastkondensatorer, keramikkondensatorer, variabla kondensatorer, elektrolytkondensatorer). Induktorer, transformatorer, ledningar, byggteknik, lödning och kontaktdon.

4 Halvledarkomponenter

Ledning i vakuum och i halvledarkristall, PN-övergången, diodekvationen och halvledardioden som komponent. Fälttransistorns och bipolartransistorns styrning och diagram. Tillverkning av en planartransistor.

5 Y-förstärkaren, dess funktion och uppbyggnad

Transistorn som signalförstärkare. Logaritmiska förstärkningsmått. AC- och DC-kopplade förstärkarsteg. RC-kretsens egenskaper. Impedans och förstärkning hos olika förstärkarsteg.

6 Differentialförstärkaren

Differentialförstärkarstegets koppling och funktion. Brus, förstärkning och bandbredd. Operationsförstärkaren. Motkoppling. Integrerade förstärkare.

Digitala delen

1 En elektronisk räknemaskin

Kort beskrivning av en enkel räknemaskin och hur de fyra räknesätten utföras. Räknemaskinen innchåller tangentbord, tre huvudregister som minnen, aritmetisk enhet samt sifferindikator.

2 Switchar och vippor. Talsystem

Transistorswitchen och dess funktion.

Bistabila vippan. Registret. Representation av tal.

Decimal och binär indikering.

3 Räknemaskinens blockschema

Addition av binära tal. En elektronisk adderare. Skiftregister. Blockschema för en förenklad additionsmaskin med tre skiftregister. Miniräknaren 1115.

4 Logiska kretsar och funktioner

Diodgrinden, NAND-kretsen. Avkodaren, adderaren, MS-vippan, skiftregistret och räknaren.

5 Facits miniräknare 1115

Bipolar- och MOS-transistorer. MOS-registret. Kretsarna i Facit 1115. Uppkopplingen av räknaren Facit 1115.

6 Datorer

Princip och blockschema för en dator. Funktionsbeskrivning av en minidator.

2.3 Kursmål

I det följande anges examinationskraven dels sammanfattande för hela kursen och dels specificerade för de olika kursavsnitten.

Examinationen förutsätter genomgångna laborationer och sker genom skriftliga flervalsprov.

De nedan specificerade kursmålen anger i vissa fall att den studerande självständigt skall producera svar, t ex kunna rita eller beskriva. Även dessa mål testas genom flervalsprov.

Sammanfattande målbeskrivning

Efter genomgången kurs skall den studerande kunna

1 använda oscilloskopet som mätinstrument. (Detta innebär att den studerande skall ha utfört laborationerna samt vid tentamen kunna ange lämpligt handlande i beskrivna mätsituationer)

2 rita blockschema för oscilloskopet och den elektroniska räknemaskinen

3 särskilja de vanligast förekommande aktiva och passiva komponenterna med avseende på terminologi, praktisk uppbyggnad och egenskaper

4 identifiera de elektroniska byggblockens funktion och principiella uppbyggnad

5 identifiera svensk och engelsk terminologi. (Detta innebär att den studerande skall kunna lösa flervalsuppgifter med såväl svensk som engelsk terminologi i svarsalternativen)

Målbeskrivning för de olika avsnitten

Efter avsnittets genomgång skall den studerande kunna

Analoga delen

1 Introduktion

1 särskilja begreppen analog och digital

2 med blockschema beskriva en analog och en digital tidmätare

3 med blockschema beskriva en princip för digital-analog-omvandling

2 Oscilloskopet

1 göra en grundinställning på ett allmänbruksoscilloskop

2 på ett oscilloskop mäta spänning och tid hos mätsignalen

3 särskilja funktionsenheterna i ett blockschema för ett oscilloskop

4 kontrollera och justera probens inställning för riktig kurvåtergivning

3 Passiva komponenter

1 identifiera vanligt förekommande komponenttyper och ange deras grafiska symboler

2 särskilja egenskaperna hos de vanligast förekommande typerna av komponenter inom grupperna R, L och C

3 ange praktiska värden på kapacitansen hos de vanligaste kondensatortyperna

4 ange impedansens frekvensberoende hos R-, L- och C-komponenter

5 ange mått på Q-värden samt förlusteffekter i R-, L- och C-komponenter

6 utföra enkel lödning

7 tolka färgkod och välja standardvärden ur E-12 serien

8 känna igen olika kontakttyper

4 Halvlederkomponenter

1 rita schemasymboler för diod, zenerdiod, PNP-transistor, NPN-transistor, N-kanal FET, P-kanal FET

2 ange funktionen hos dioden, NPN-transistorn och N-kanal FET med hjälp av potentialmodell

3 skriva diodekvationen samt sambandet mellan utström och inspänning hos bipolar- och fälttransistorn

4 med hjälp av modellerna i punkt 2 ovan förklara bipolar- och fälttransistorns höga utimpedans

5 känna till det aktiva områdets begränsning i kollektordiagrammet med avseende på ström, spänning och effekt

5 a Det enkla transistorsteget

1 ange innebörden av begreppet arbetspunkt samt ange symboler för de storheter som är av intresse i punkten

2 definiera begreppen förstärkning och utstyrning

3 definiera begreppet spänningsförstärkning yttryckt linjärt och i d B. (Exempelvis kunna omvandla de linjära spänningskvoterna 0,1, 1, 2, 10, 100, 1000 till d B)

4 rita upp och beskriva ett enkelt förstärkarsteg med bipolartransistor

5 rita signalschema och ekvivalentschema för ett givet enkelt förstärkarsteg

6 beräkna förstärkningen hos ett givet enkelt förstärkarsteg

5 b Y-förstärkaren

1 rita och beskriva RC-länkens språngsvar och frekvenskurvor. (Ex. HP- och LP-länkens språngsvar).

2 ange sambandet mellan stigtid och gränsfrekvens

3 rita scheman för ett GE-steg och en emitterföljare

4 ange typiska värden för in- och utimpedansen samt förstärkningen hos ett GE-steg och en emitterföljare

5 identifiera förstärkarsteg i ett givet kopplingsschema

6 Differentialförstärkaren

1 rita kopplingsschemat för ett differentialsteg

2 beskriva differentialstegets funktion med hjälp av potentialmodell

3 definiera begreppen "common mode" och "differential mode"

4 beskriva varför man i oscilloskopets differentialförstärkare inte kan utnyttja godtyckligt hög förstärkning medan man i operationsförstärkaren eftersträvar när oändlig förstärkning

5 rita schema och karaktäristik för spännings- och strömgenerator

6 ange skillnaden mellan bipolar- och fälttransistor med avseende på impedans och brus

Digitala delen

1 En elektronisk räknemaskin

1 rita ett förenklat blockschema för en elektronisk räknemaskin

2 särskilja informations- och styrvägar i blockschemat

3 ange funktionen i blockschemat vid nollställning av räknaren och vid addition av två tal

4 ange grundprincipen för hur de fyra räknesätten kan utföras enbart med hjälp av addition, skift och komplementering

2 Switchar och vippor. Talsystem

1 Definiera bottnad, strypt och i aktiva området ledande transistor och ange de storheter som karaktäriserar bottnat och strypt tillstånd

2 rita schema för bistabil vippa och ange villkoren för transistorernas bottning och strypning

3 ange det binära innehållet i en vippa med hög representation

4 med hjälp av bistabila vippor representera tal enligt binär kod och NBCD-kod

5 ange för ett givet register kapaciteten uttryckt i ord av given längd, bitar samt decimala siffror vid NBCD-kod

3 Räknemaskinens blockschema

1 addera binära tal

2 rita funktionstabell för binär adderare

3 beskriva funktionen för ett skiftregister

4 rita blockschema för en additionsmaskin bestående av adderare samt tre skiftregister

5 ange deloperationerna vid addition av två binära tal i en räknemaskins blockschema

4 Logiska kretsar och funktioner

1 rita kretsschema för diodgrind och NAND-krets samt blockschema för MS-vippa

2 rita diodavkodare för 4-bitars register (med komplementära utgångar tillgängliga)

3 rita blockschema och ange funktionen för skiftregister uppbyggt av MS-vippor

4 rita schema och ange funktionen för 4-stegs binärräknare uppbyggd av MS-vippor

5 Facits miniräknare 1115

1 identifiera MOS-transistorer i LSI-kristall

2 rita blockschema för dynamiskt skiftregister

3 identifiera LSI och MSI-kretsar, drivkretsar för indikatorer, indikatorer och nätaggregat i en elektronisk bordskalkylator med integrerad uppbyggnad

6 Datorer

1 ange uppgifterna hos huvuddelarna i en dator (incrgan, utorgan, yttre och inre minnen, styrenhet och aritmetisk enhet)

2 ange informationsvägar och styrvägar i en dators blockschema

3 Undervisningsmodell

Förutom introduktion och tentamen omfattar modellen 12 paket med följande innehåll:

Analoga delen

1 Byggblock och funktionsenheter

2 Oscilloskopet

3 Passiva komponenter

4 Halvledarkomponenter

5 Enkla förstärkarsteg

6 Differentialförstärkaren

Digitala delen

1 En elektronisk bordsräknemaskin

2 Switchar, vippor och talsystem

3 Räknemaskinens blockschema

4 Logikkretsar

5 Räknemaskinens uppbyggnad

6 Datorer

Laborationernas innehåll

Oscilloskopet

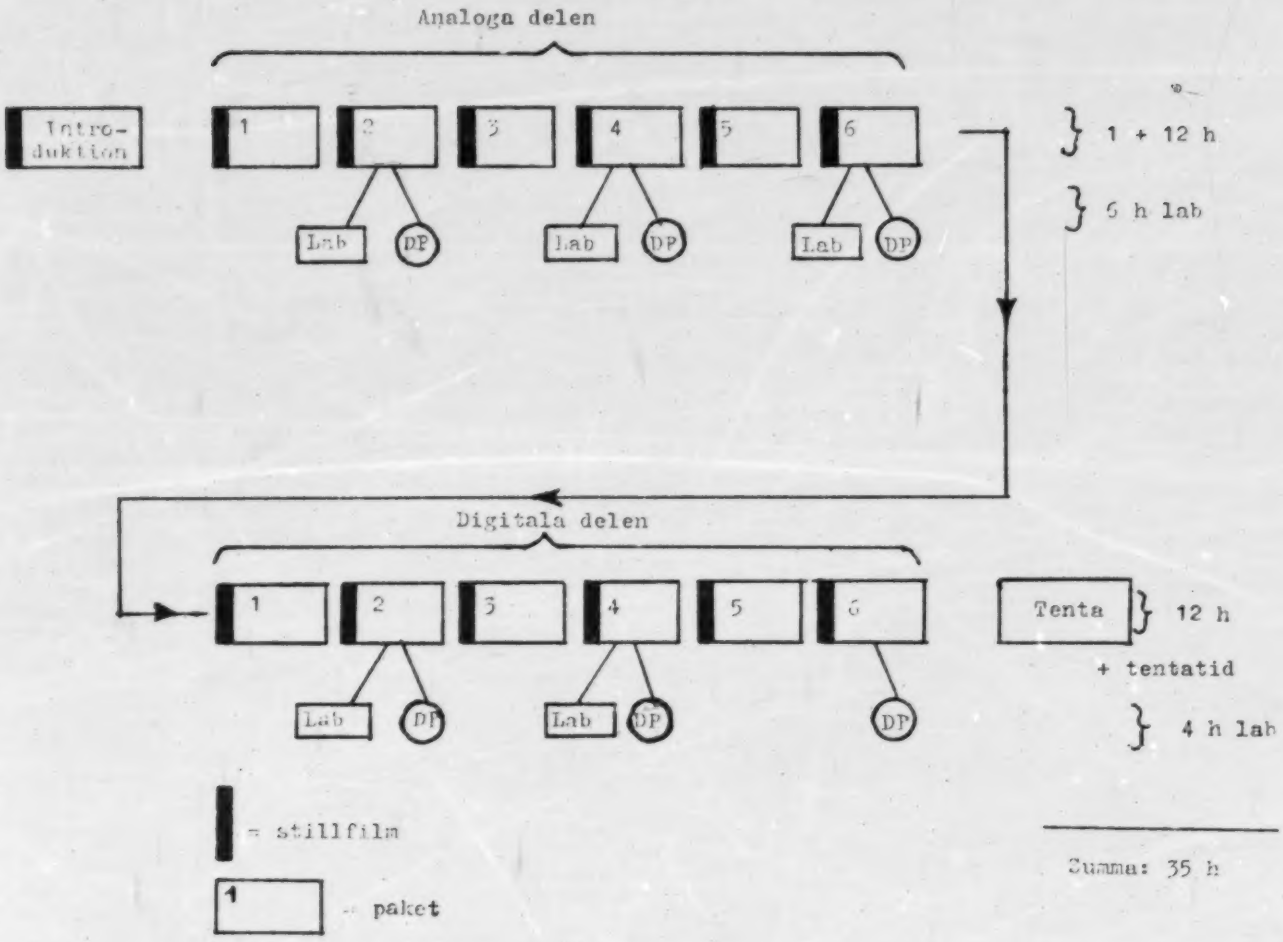
Transistorn

GE-steget (+ demonstr av OP-förstärkare)

Enkel vippa (+ demonstr av MS-vippa)

Register och räknare (+ demonstr av minidator)

MODELL



Expertgruppen är enig om att måldokumentet snarast bör omsättas i ett läromedel innehållande följande komponenter.

1) inledande stillfilm om kursens innehåll, läromedleds omfattning och lämplig studieteknik.

2) motiverande och förproducerade inledningsavsnitt till varje paket i form av stillfilmer.

3) kurskompendium med målbeskrivning till självstudiearbetet för varje paket.

4) diagnostiska prov för kontroll av självstudierna (flervalstest av samma typ som tentamen).

5 laborationer med självinstruerande PM.

6) frågebank för hjälp till självstudierna.

7) prototyptentor (till hjälp för lärarna under kursens inkörning).

Som ett läromedel bör kursen evalueras för kommande revideringar speciellt med tanke på anpassningen till kursens många olika avnämare.

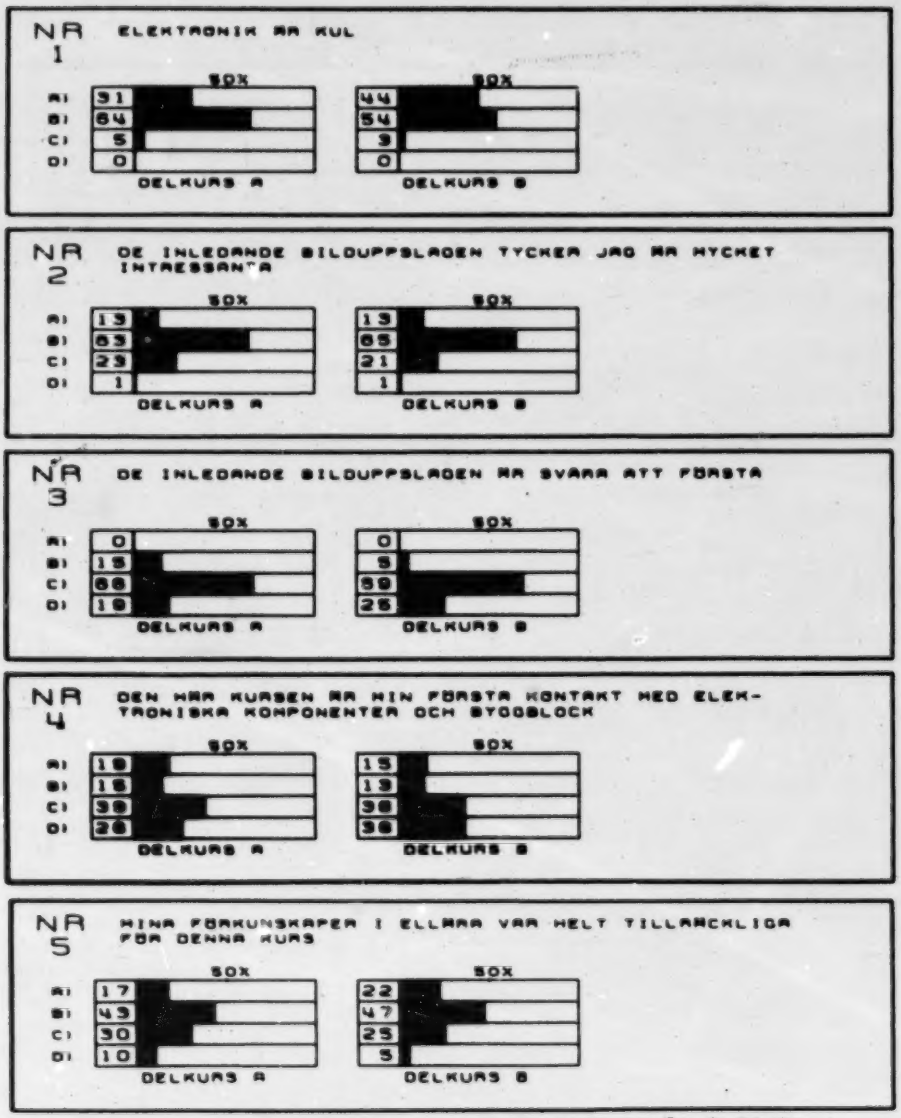
Ekonomi

Med ledning av PE-gruppens erfarenheter från liknande läromedelsproduktioner kan följande ungefärliga uppskattning göras av kostnaderna:

13 stillfilmer à 15 kkr	195 kkr
6 diagnostiska prov à 3 kkr	18 kkr
5 laborationer (+ PM) à 4 kkr	20 kkr
2 prototyptentor à 4 kkr	8 kkr
frågebank (rep.frågor)	10 kkr
datarättning 1 år 1 000 elever	10 kkr
evaluering + bearbetning	15 kkr
Summa:	276 kkr

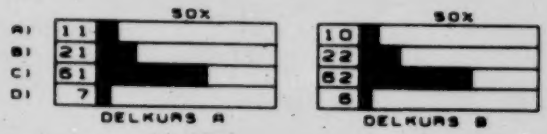
RESULTAT FRÅN ELEVENKÄTER FÖR ELEKTRONIK" INLEDANDE KURS A OCH B FÖR GYMNASIETS ÅRSKURS 3.

1. Läsåret 1970/1971. Samma test kördes efter båda delkurserna. 335 elever svarade efter delkurs A, höstterminen 1970. 168 elever svarade efter delkurs B, vårterminen 1971. Testet omfattar 34 påståenden som alla värderats efter skalan
A) instämmer helt
B) instämmer
C) instämmer inte
D) instämmer absolut inte

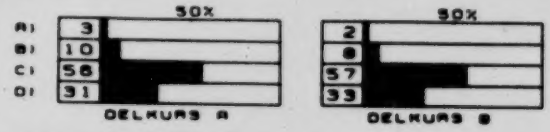


PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS GY ÅK 3 70/71

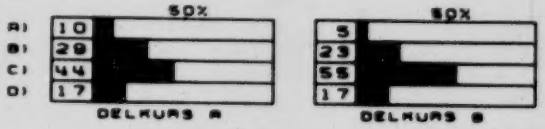
NR 6 DET JAG LÄRT MIG UNDER KURSEN HAR JAG LÄST IN SJÄLV



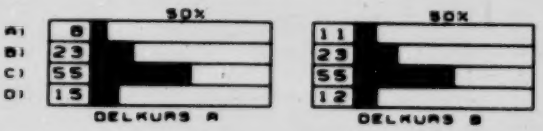
NR 7 LABORATIONERNA BEGRIPER JAG INTE ETT DUGG AV



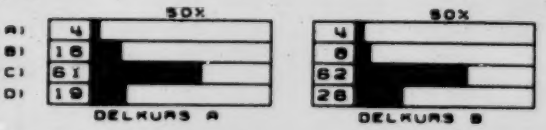
NR 8 LABORATIONERNA TAR ALLDELES FÖR LÅNG TID



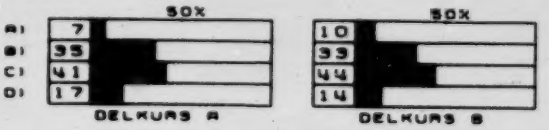
NR 9 FÖRBEREDELSEARBETET TILL LABORATIONERNA ÄR ALLDELES FÖR OMFATTANDE



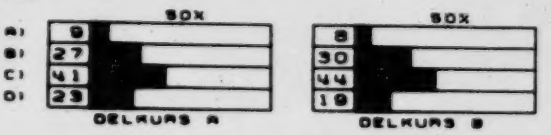
NR 10 KURSBOKEN VAR ALLDELES FÖR SVÅR



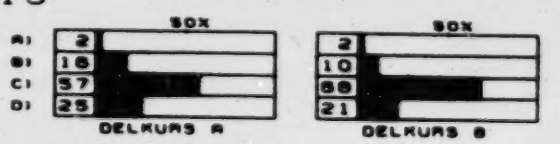
NR 11 DE DIAGNOSTISKA PROVEN LÄR JAG MIG MYCKET AV



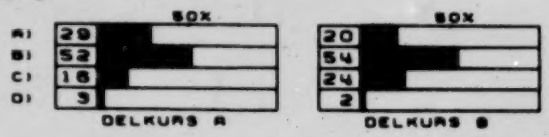
NR 12 JAG ÄR HELT NÖJD MED MINA DIAGNOSTISKA PROVRESULTAT



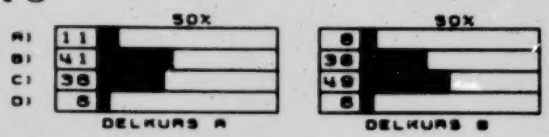
NR 13 JAG TYCKER ATT DET ÄR FÖR FÅ DIAGNOSTISKA PROV



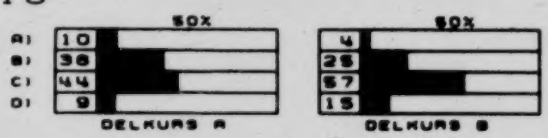
NR 14 HÄLAUTAN TYCKER JAG ÄR EN MYCKET BRA VÄGLEDNING I STUDIEARBETET



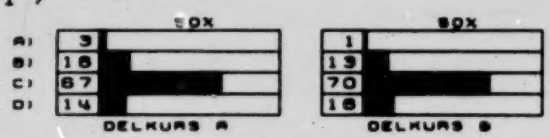
NR 15 JAG SKULLE VILJA HA HÄLAUTAN MYCKET MER DETALJERAD



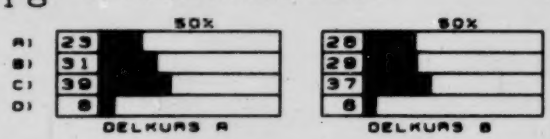
NR 16 JAG TYCKER ELEKTRONIK ÄR SVÅRT



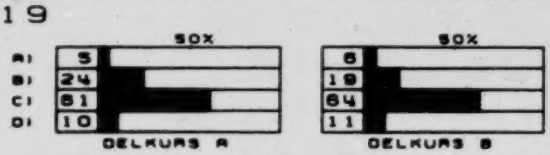
NR 17 JAG TYCKER ATT DE DIAGNOSTISKA PROVEN ÄR ALLDELES FÖR SVÅRA



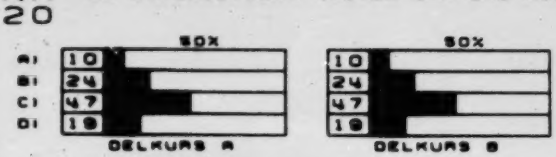
NR 18 JAG SKULLE VILJA HA MYCKET LÄNGRE BETÄNKETID UNDER DE DIAGNOSTISKA PROVEN



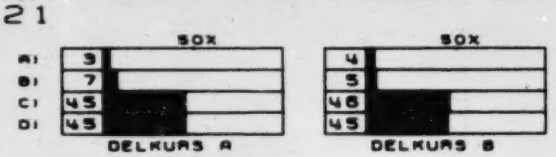
NR 19 KOMMENTARERNA TILL DP-FRÅGORNA ÄR ALLDELES FÖR KORTA



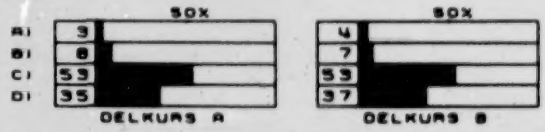
NR 20 DE DIAGNOSTISKA PROVEN LÄR JAG MIG INGENTING AV



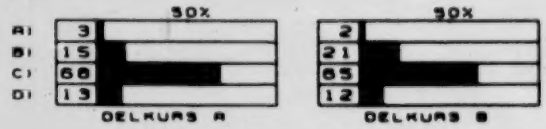
NR 21 SAMMANFATTNINGEN I KURSBOKEN BRYR JAG MIG ALDRIG OM



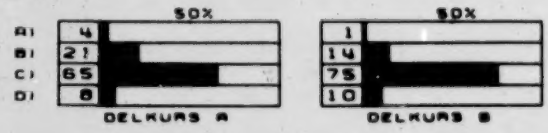
NR 22 JAG STAUNTAR I MINA DIAGNOSTISKA PROVRESULTAT



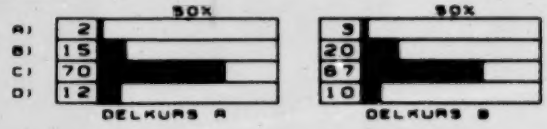
NR 23 JAG TYCKER DE DIAGNOSTISKA PROVEN ÄR FÖR LÄTTA



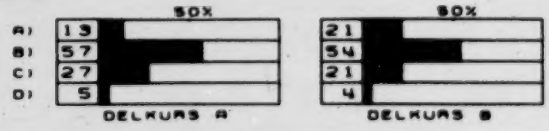
NR 24 TEXTEN I KURSBOKEN ÄR ALLDELES FÖR KORTFATTAD



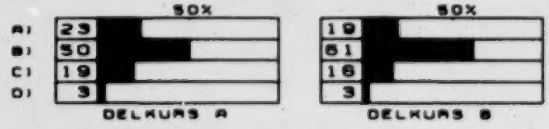
NR 25 LABORATIONSBESKRIVNINGARNA ÄR ALLDELES FÖR OMFATTANDE



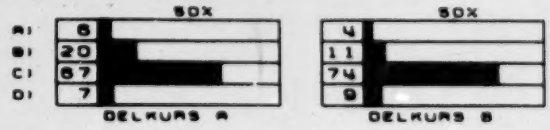
NR 26 KURSEN HAR ÖKAT MITT ELEKTRONIKINTRESSE I HÖG GRAD



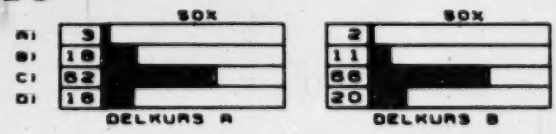
NR 27 JAG TROR ATT MIN LÄRARE ÄR MYCKET POSITIV TILL DET HÄR KURSMATERIALET

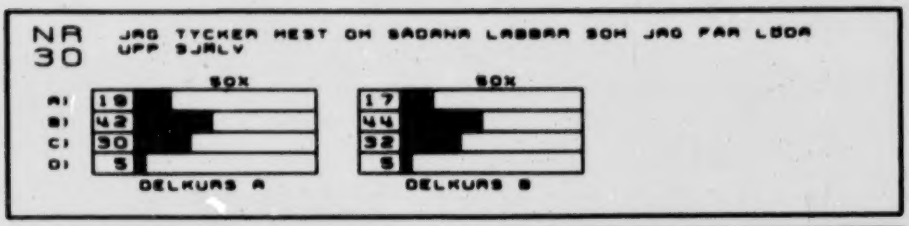


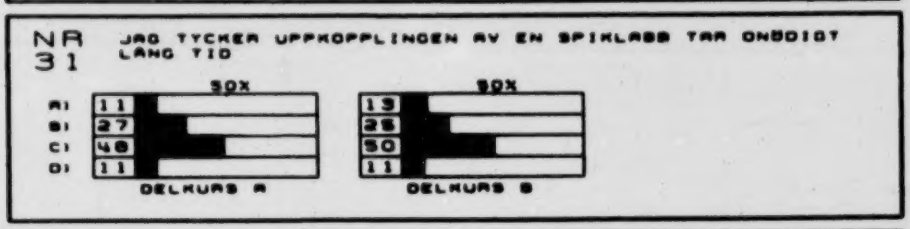
NR 28 KURSEN ÄR ALLDELES FÖR YTLIG

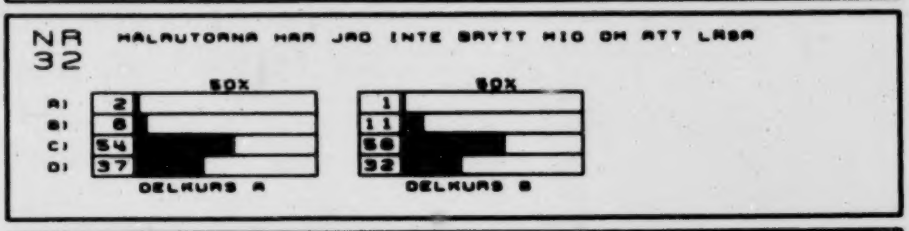


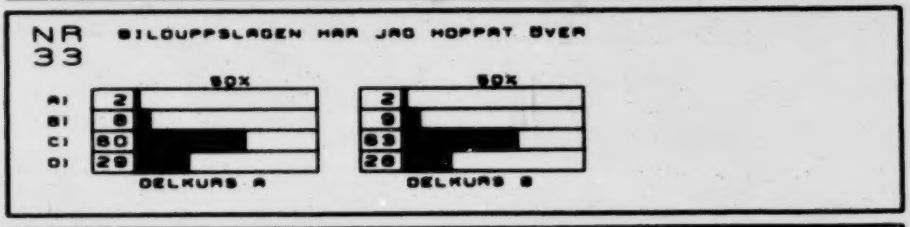
NR 29 KURSEN KRÄVDE FÖR MYCKET FÖRKUNSKAPER I MATTE OCH ELLÄRA

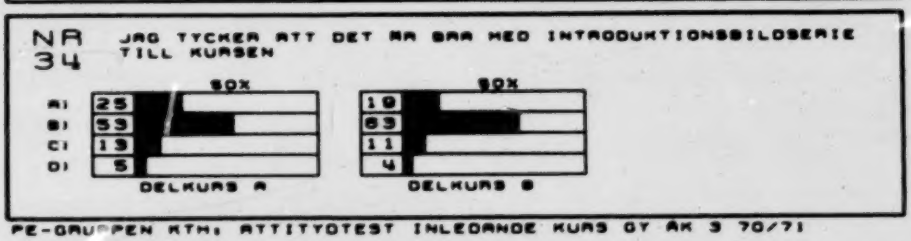








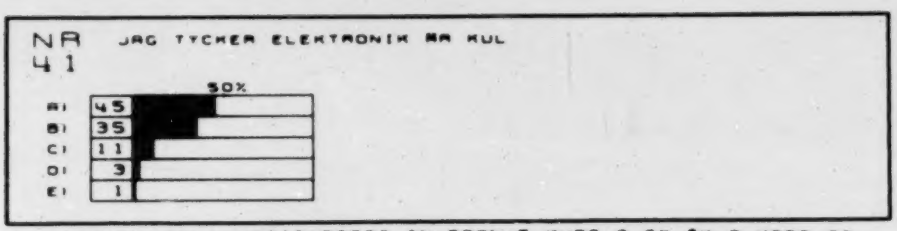




PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS GY AK 3 70/71

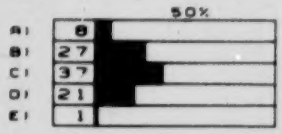
2. Höstterminen 1971. 418 elever svarade efter delkurs A. Testet omfattar 20 påståenden som alla värderats efter skalan

A) instämmer helt
B) instämmer
C) obestämd
D) instämmer inte
E) instämmer absolut inte

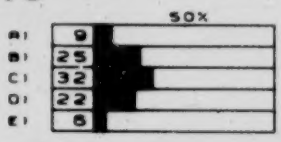


PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS A GY AK 3 MARS 72

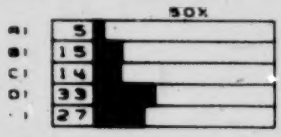
NR 42 ÖVNINGSUPPGIFTERNA VAR ALLDELES FÖR SVÅRA



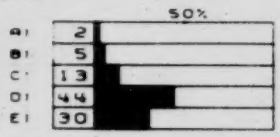
NR 43 KUNSKAPSTESTEN I ÖVNINGSBOKEN HAR JAG HAFT STOR NYTTA AV



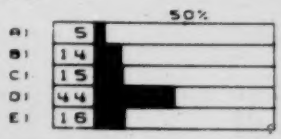
NR 44 JAG HAR RÄKNAT EN STOR DEL AV ÖVERKURSUPPGIFTERNA I ÖVNINGSBOKEN



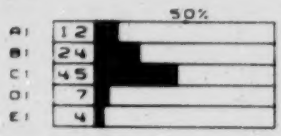
NR 45 JAG STRUNTAR I MINA DIAGNOSTISKA PROVRESULTAT



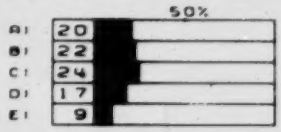
NR 46 JAG TYCKER INTE DE DIAGNOSTISKA PROVEN FRÅGAR OM DET SOM VI LÄSER



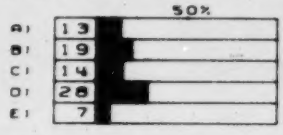
NR 47 DEN INLEDANDE LJUDBILDSERIEN TILL DEL A VAR MYCKET BRA SOM INTRODUKTION TILL KURSEN



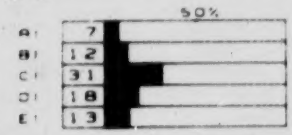
NR 48 JAG HAR HAFT STOR NYTTA AV FACIT I ÖVNINGSBOKEN SÅ FORT DET HAR TAGIT EMOT ATT RÄKNA EN UPPGIFT



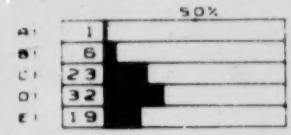
NR 49 FÖRBEREDELSEUPPGIFTERNA TILL LABBARNA HAR JAG HUVUDSAKLIGEN GJORT HEMMA



NR 50 TROR ATT RESULTATEN PÅ MINA DP-PROV INVERKAR MYCKET PÅ MITT SLUTBETYG

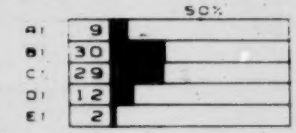


NR 51 BILDUPPSLAGET FÖRE VARJE KAPITEL HAR VARIT SVÅRA ATT FÖRSTÅ

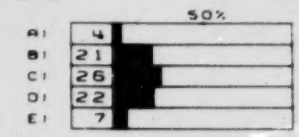


NR 52 JAG TYCKER DET ÄR SKÖNT ATT HA MÅLRUTORNA ATT GÅ EFTER I STUDIEARBETET

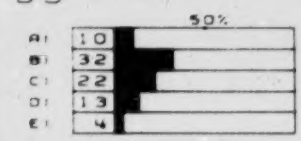
NR 53 JAG TYCKER ATT JAG REDAN HAR MUNNIT LÄRA MIG MYCKET OM ELEKTRONIK I DEN HÄR KURSEN



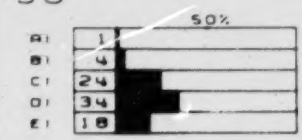
NR 54 AVSNITTET OM HALVLEDARNAS LEDNINGSMEKANISMER (I KAP 4) VAR LÄTT ATT FÖRSTÅ



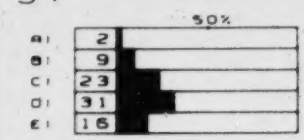
NR 55 JAG HAR LÄRT MIG EN HEL DEL AV DE DIAGNOSTISKA PROVEN



NR 56 JAG TYCKER PROBLEMDELEN PÅ TENTAN VAR ALLDELES FÖR LÄTT



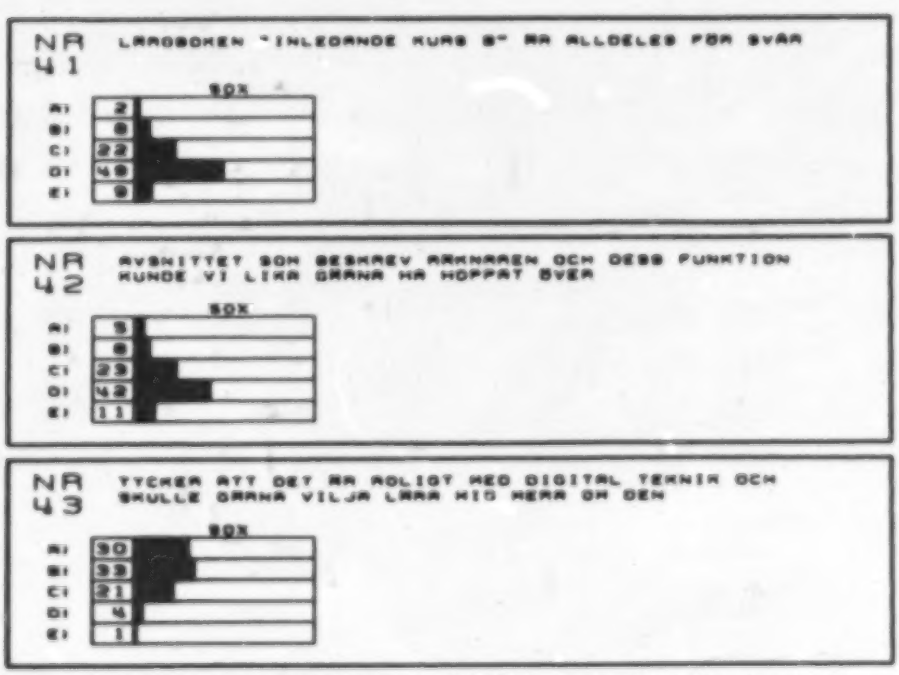
NR 57 BILDUPPSLAGEN SOM INLEDER VARJE KAPITEL ÄR HELT OINTRESSANTA OCH SKULLE LIKA BRA KUNNA SLOPAS



PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS B GT ÅR 3 HARS 72

3. Vårterminen 1972. 274 elever svarade efter delkurs B. Testet omfattar 19 påståenden som alla värders efter skalan

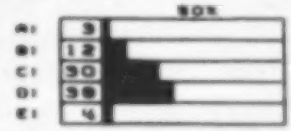
A) instämmer helt
B) instämmer
C) obestämd
D) instämmer inte
E) instämmer absolut inte



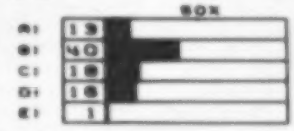
PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS B GT ÅR 3 MAJ 72

NR 44 SKULLE HELLRE VILJA RONA MERA TID AT ANALOG TEKNIK (KURS A) DEN HAR TERMINEN OCH INTE LASA NAGON DIGITAL TEKNIK (KURS B)

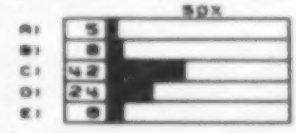
NR 45 TYCKER ATT OVNINGSUPPGIFTERNA HAR VARIT FOR SVARA



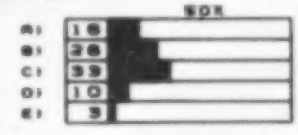
NR 46 OVNINGSUPPGIFTERNA HAR JAG FOR DET MESTA KUNNAT LOSA PA EGEN HAND



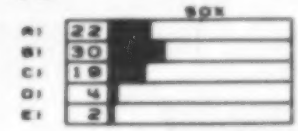
NR 47 FORBEREDELSEUPPGIFTERNA TILL LABORATIONERNA AR DET MYCKET ROLIGARE ATT ARBETA MED AN OVNINGSUPPGIFTERNA



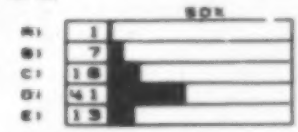
NR 48 LABORATIONERNA HAR VARIT DEN INTRESSANTASTE DELEN AV KURSEN



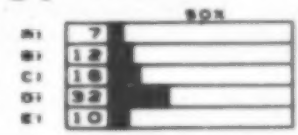
NR 49 LABORATIONSMATERIELEN (PLATTORNA FRAN TERCO) TYCKER JAG DET AR LATT OCH TREVLIGT ATT ARBETA MED



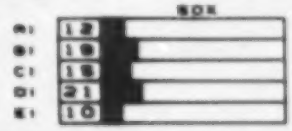
NR 50 LABORATIONSUPPGIFTERNA HAR VARIT ALLDELES FOR SVARA



NR 51 FORBEREDELSEUPPGIFTERNA TILL LABORATIONERNA HAR JAG INTE SETT MIG OM ATT ARBETA IGENOM

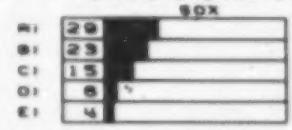


NR 52 JAG SYSSLAR PA MIN FRITID EN HEL DEL MED ELEKTRONIK

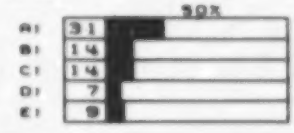


NR 53 DIAGNOSTISKA PROVEN HAR VARIT ALLDELES FOR LATTA

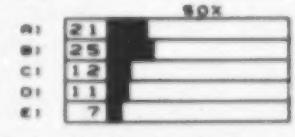
NR 54 EFTER SJALVA OP-PROVET BRUKAR VI ALLTID I VAR KLASS HA DISKUSSION OCH GENOMGANG AV FRAGOR OCH SVARSALTERNATIV



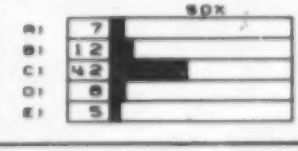
NR 55 OP-PROVEN BRUKAR MIN LARARE ALLTID SVARSARTTA



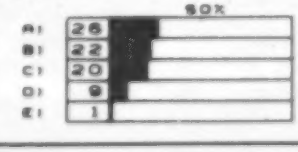
NR 56 INFOR ETT OP-PROV BRUKAR JAG ALLTID REPETERA KURSAVSNITTET OCH LASA PA EXTRA



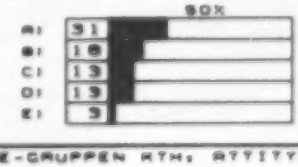
NR 57 DEN INLEDANDE LJUDBILDSERIEN TILL DEL B TYCKTE JAG VAR EN FIN INTRODUKTION TILL KURSEN



NR 58 VI HADE ALLDELES FOR KORT TID TILL FORFOGANDE FOR INLEDANDE KURS A



NR 59 TIDEN FOR DEN HAR TENTAN (KURS B) TYCKER JAG VAR ALLDELES FOR KORT



PE-GRUPPEN KTH: ATTITYDTEST INLEDANDE KURS B GY AK 3 MAJ 72

AB LÄROMEDELSFÖRLAGEN
P.A.NORSTEDT & SÖNER – ALBERT BONNIER

Elektronik, Inledande kurs

Lärarenkät

Lärare: *Sammanfattning av lärarenkätsvar*

Skola: *Kurs A: 16 lärare Kurs B: 11 lärare*

Adress: *Samma enkät användes efter båda delkurserna*

För att bättre kunna följa upp och revidera den här kursen är vi intresserade av Dina erfarenheter och synpunkter på metoder och kursmaterial.

Frågorna har till övervägande delen fasta svar, men Dina egna kommentarer är givetvis minst lika viktiga.

Tack för hjälpen!

	Kurs A	Kurs B
1. I vilket eller vilka av följande ämnen undervisar Du?		
0 systemteknik	2	1
0 kommunikationsteknik	4	2
0 reglerteknik	2	1
0 elektronik	15	10
0 ellära	13	9
0 fysik	2	0
0 andra ämnen	2	3
2. Vad anser Du om elektronikkursens målspecifikation?		
Bra	8	5
Övriga kommentarer (för omfattande m m)	3	2
Ingen kommentar	3	4
3. I vilken utsträckning har eleverna fått ägna sig åt självstudier på lektionstid?		
0 inte alls	1	1
0 0 - 25 %	11	8
0 25 - 50 %	3	1
0 > 50 %	1	1
Kommentar:		
4. Har samtliga elever haft tillgång till laborationshäfte?		
0 ja	16	11
0 endast ett för varje lab.-grupp	0	0
0 nej	0	0
Kommentar:		

5. Var laborationshäftet för omfattande?

	Kurs A	Kurs B
O ja, mycket	0	0
O ja, något	5	3
O nej	11	7
O nej, borde varit utförligare	0	0

6. Egna synpunkter på laborationshäftet

.....

.....

7. Är målrutorna tillräckligt preciserade för att ange ramarna kring veckans arbete?

O ja	13	10
O nej	3	1

Kommentar: .....

.....

8. Ger laborationshäftet tillräcklig information för laborationernas genomförande?

O ja	16	11
O nej	0	0

Kommentar: .....

.....

9. Saknar Du litteraturreferenser för merläsning?

O ja	4	2
O nej	12	9

Kommentar: .....

.....

10. Har eleverna genomfört samtliga laborationer?

O ja	13	2
O nej, inte nr	3x)	7xx)

Kommentar: x) 3 som ej gjort lab. 4 ... xx) 3 som ej gjort lab. 3+4,

.....1 " " " " 3+4+5....

1 " " " " 5

1 " " " " 4+5

1 " " " " 7+8

11. Har Du inköpt de färdiga laborationssatser som finns till serien?

O ja	14	10
O nej	1	0
O delvis	1	1

12. Egna synpunkter på komponentanskaffningen

.....

.....

13. Hur många timmar har Dina elever i genomsnitt använt för varje laboration på labbet?

	Kurs A	Kurs B
0 1 tim.	0	0
0 2 tim.	1	4
0 3 tim.	9	5
0 4 tim.	4	1
0 fler än 4 tim.	2	1

14. Egna synpunkter på laborationerna

.....

.....

15. Vad anser Du om antalet förberedelseuppgifter och övningsuppgifter i laborationshäftet?

0 för få	4	2
0 lagom	9	7
0 för många	3	2

16. Vilka laborationer var alltför omfattande?

Lab. nr .....

nr		
1	0	2
2	2	2
3	2	0
4	5	0

17. Har Du använt samtliga diagnostiska prov?

0 ja	11	2
0 nej, inte nr		
nr		
4	5	0
7,8	0	9

18. Hur var svårighetsgraden på de diagnostiska proven?
Markera med kryss i rutan för varje prov.

	Kurs A				Kurs B			
	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8
Alltför svårt								
Något för svårt	0	0	3	2	0	0	1	1
Lagom	7	10	11	7	9	8	2	1
Något för lätt	5	5	0	1	1	0	0	1
Alltför lätt	3	0	0	0	0	1	0	0

19. Anser Du att de diagnostiska proven verkat aktiverande på eleverna?

	Kurs A	Kurs B
0 ja, mycket	7	6
0 i viss mån	7	4
0 inte alls	1	0

20. Hur har Dina elever reagerat för betänketiderna i de diagnostiska proven?

Betänketiderna var	Kurs A	Kurs B
0 för långa	1	2
0 lagom	12	6
0 för korta	3	2

21. Har de diagnostiska proven som regel åtföljts av diskussion kring de givna problemställningarna?

0 ja	2	2
0 nej	2	1
0 ibland	11	7

22. Har Du snabbrättat de diagnostiska proven i Din klass?

0 ja	11	6
0 nej	5	1

23. Har resultatet av snabbrättningen påverkat Din undervisning för de olika avsnitten?

0 ja	3	0
0 nej	7	7
0 ibland	6	3

24. Jag skulle föredra smådia (5 x 5 cm) istället for stordia för presentation av de diagnostiska provfrågorna.

0 ja	7	5
0 nej	7	5
Spelar ingen roll	1	1

Kommentar: .....

.....

25. Vilken värdering skulle Du vilja ge dessa komponenter i ett tänkt läromedelssystem?
Skala: 5 absolut nödvändigt - 1 ovidkommande
Försök att differentiera Din värdering!

	Kurs A		Kurs B	
	poäng	rang	poäng	rang
- Lärobok	70	1	55	1
- Arbetsbok	54	2	47	2
- Diagnostiska prov	53	3	43	3
- Motiverande ljudbildserier el. TV-program	42	8	36	6
- Färdiga laborationssatser	45	7	38	5
- Rättningsservice på de diagnostiska proven	37	9	25	10
- Service med tentor och rättning	52	4	38	5
- Lärarhandledning	47	6	38	5
- Informationsträffar för lärare om pedagogisk uppläggning och kursinnehåll	42	8	32	7
- Målspecifikation	48	5	29	4
- Litteraturanvisningar för högpresterande elever	33	11	26	9
- Extra övnings- och arbetsmaterial för lågpresterande elever	36	10	30	8

26. Har Ni tillgång till räknaren Facit 1115 till den digitala delen av kursen?

	Kurs A	Kurs B
0 ja	8	4
0 osäkert	1	0
0 nej	5	5

27. Vad anser Du om introduktionsljudbildserien?

0 bra	8	4
0 mindre bra	1	1
0 har inte använt den	5	6

Kommentar: .....

.....

ELECTRONIC EDUCATION

Pricelist 1.3.1972

Electronics, Introductory course has been developed by Gunnar Markesjö and the PE-group (pedagogical research) at the Royal Institute of Technology, Stockholm.

For your information we can mention our prices for the Swedish schools:

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Sound-film-strip, Introduction A (50 colour-slides and tape)	150:-	31.50
Sound-film-strip, Introduction B (45 colour-slides and tape)	150:-	31.50
Diagnostic tests A (48 transparencies and 4 tapes)	420:-	88.00
Diagnostic tests B (48 transparencies and 4 tapes)	420:-	88.00
Students material (produced by Läromedelsförlagen AB)		
Text-book, Course A (150 p)	24:-	5.00
Text-book, Course B (108 p)	19:-	4.00
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